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ICTs application and its relationship to job performances of extension workers in North Central Nigeria

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The study centered on (ICTs) application and its relationship to the job performances of extension workers in North central Nigeria. A structured questionnaire was administered to 291 extension workers. A sampling method with a mixture of techniques was adopted. Descriptive statistics, Z test, Pearson correlation, and Factor analysis were employed. A significant majority 87.6 % often used Facebook, 86.9% What's app, and 84.2% internet sources/mobile/smartphone. Factors affecting ICTs application, Factor 1 having high loading were lack of availability of professionals for training, gender issues, lack of Government intervention, and lack of monitoring and evaluation from the government. Factor 2 with higher loading was the need for ICTs infrastructure and inadequate availability of electricity. Factor 3 with high loading was high equipment cost and poor income. Among the three factors that contributed most to explaining the total challenges of ICTs training and application is factor 1 with about 20.5%, followed by factor 2 which accounted for 18.6%. There was a significant difference between gender and performances at a 0.05 level. There was a positive and moderate effect and significant correlation at 0.01 level between ICTs application (r=0.309) and job performance at P<0.01. ICTs application also had a small effect and Positive and significant association with the Quantity of work, quality of work, and speed of work at a 1% level of significance. It is recommended that the Government should intervene through equality professional training and set up a good monitoring team to encourage effective ICTs applications directed towards organizational development.
Keywords: ICTs, application, relationship, performances, extension workers.

INTRODUCTION

Information and communication technologies are the most important tool that is most frequently used in the agricultural sector, and this may significantly lead to a country's economy expanding (Pande and Deshmukh, 2015). ICT applications in agriculture may promote national economic growth. The international community uses ICTs as a vital building block to monitor development, validate conceptual models, and package and disseminate approaches once they have been tested (Pande and Deshmukh, 2015). ICTs help create awareness among farmers and artisans about the importance of effective natural resource management and planning through the use of a Geographical Information System (GIS). Furthermore, it might make it simpler for rural residents to partake in endeavors like distance education, telemedicine, and remote public service delivery, promoting a healthy and effective rural lifestyle and its inhabitants (Bhalekar *et al.* 2015). (Bhalekar *et al*. 2015; Onyema and Chiemek, 2023) discovered a significant positive correlation between ICT usage and employee performance. Several factors, including institutional, infrastructural, and socioeconomic ones, have an impact on how extension officers adopt and use ICTs. The high cost of ICTs, electricity issues, a lack of training, ICT illiteracy, outdated content, inability to use ICTs, and network issues are just a few of the obstacles to using ICTs in extension work (Sa, adu, *et al*. 2022).

Agricultural extension services have reportedly long been criticized for being ineffective (Nwosu *et al.* 2015). The majority of extension staff in Nigeria, have access to computers, radios, telephones, televisions, and video recording equipment, which they could use to provide all of their services if given the proper training, infrastructure, and funding (Agwu and Nwokorie, 2019). ICTs in agricultural extension have been the subject of extensive research, however, no one has approached it from the perspective of

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information and communication technologies (ICTs) application and its relationship to the job performance of extension workers in North Central Nigeria. Notwithstanding this, empirical research among its users in the sector is set to confirm these assertions.

The main objective of this study was to assess the ICTs application and its relationship to the job performances of extension workers in North Central Nigeria. The outcome of this study will guide the extension organization to acquire the required skills and background knowledge for the extension workers. This is the birth to enhance their job performance to effectively disseminate innovation to farmers, altering a positive change in their behavior, farming productivity, livelihood, income, and food security. The study-specific objectives were: (a) to identify the ICTs usage/application profile and (b) to determine factors affecting ICTs usage/application among extension services. (c) determine the relationship between ICTs application and job performances and its dimensions (d) determine the significant differences between gender and job performances of the respondent

MATERIALS AND METHODS

The Savanah Agro-Ecological Zone includes the Federal Capital Territory of Abuja, Nasarawa, Benue, Kogi, Niger, and North Central Nigeria, which is part of the southern Guinea Plateau (National Bureau of Statistics 2019). It is located between longitude 2°301E and latitude 6°301N. There are two distinct seasons in the region: dry and wet. According to the National Population Commission's 2009 estimate, North Central Nigeria has a land area of about 251,425 square feet, a population of about 20,266,257 people, and a mixture of ethnic groups. The researcher used multi-stage cluster sampling and stratified sampling procedures to select the sample for the study. Krejcie and Morgan's Table (1970) recommended the selection of 291 participants. In the first stage, from the existing seven (7) states that make up the North Central Zone of Nigeria, which serve as the population of the study with a total number of (1,933) extension agents, four states were purposively selected (Benue, Plateau, Nasarawa, and Abuja), (Agricultural Development Programme 2020). The reasons for eliminating the three states (Kwara, Kogi, and Niger), Kogi and Niger are vulnerable to the worsening situation of insecurity by bandits and kidnappers. Additionally, their level of exposure to ICTs is not as profound as the selected zones in the study. While Kwara State was eliminated from the actual study because the pilot study was conducted in the state. In the second stage, a sampling was drawn from the four (4) states (Plateau 305, Benue 427, Nasarawa 289, and Abuja 259), with a total population of (1,280). It was extracted proportionately which gave rise to 291 sample size for this study. (Kumar, 2011) as shown in Table 2 and Fig. 1 using the formulae;

$$\text{Proportion (P)} = \frac{(\text{number of elements in each stratum})}{Total\ population\ size} = \frac{(\text{number of extension agents in each state})}{1280}$$

Sample selected from the State is = Sample size × P

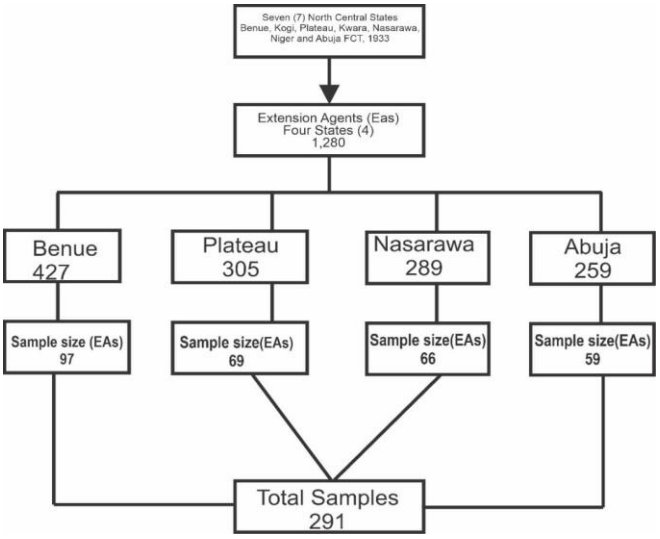

Figure 1.The Sampling Procedure (Multi-stage).

Table 1. The Sampling procedure (Proportionate).

States (population of EAs)	Sample States	Population of EAs	Procedures	Sample
1. Plateau (305)	1. Plateau	305	305/1280 = 0.238 0.238 × 291 = 69.2	69
2. Kwara (222)	3. Nasarawa	289	289/1280 = 0.226 0.226×291 = 65.8	66
	4. .Abuja	259	259/1280 = 0.202 0.202×291 = 58.7	59
3. Nasarawa (289)				
4. Abuja (259)				
5. Benue (427)	5.Benue	427	427/1280 = 0.333 0.333 × 291 = 96.9	97
6. Kogi (178)				
7. Niger (253)				
Total of 1933		1280	291	291

RESULTS

***The application and usage profile of ICTs*:** The application and usage profile of ICTs by the respondents were presented and discussed in this section. Descriptive statistics were employed, including frequency and percentage tables. The outcomes are displayed below. The result in Table 2 revealed the respondent's ICTs application and usage profile. Based on ranking, significant majority 87.6 % often used Facebook, 86.9% WhatsApp, 84.2% internet sources/ Mobile/ smartphone, Desktop computer 46.7%, 39.2% Laptop computer, 37.5% telegram, IPad/Tablet 34.0%, E-extension 27.5%, 21.9% Twitter, 17.9 % Plantix, 10.6% Plantwise Fact sheet, and Open data ICTs app 3.4%. The results indicate that among extension workers, Facebook, Whatsapp, and internet resources/mobile/smartphones were the most relevant and useful ICTs tools. This could be because extension workers are unaware of new ICTs tools that are available for agricultural and extension enterprises, or because they are limited by a lack of ICTs infrastructure, funding, and appropriate training that would enable them to adopt new ICTs tools.

Table 2. Respondents' ICTs application and usage profiles (n=291).

Variables	Frequency	Percentage	Rank
Facebook	255	87.6	1
WhatsApp	253	86.9	2
Internet source/ Mobile/ smartphone	245	84.2	3
Desktop computer	136	46.7	4
Laptop computer	114	39.2	5
Telegram	109	37.5	6
IPad/Tablet	99	34.0	7
E-extension	80	27.5	8
Twitter	64	21.9	9
Plantix App	52	17.9	10
Plant-wise Fact sheet	31	10.6	11
Open data ICTs app	10	3.4	12

Multiple responses*

***Problems and challenges faced by ICTs training and Application*:** The result in Table 3 indicated the challenges faced by respondents in ICTs training and application which were determined using factor analysis. For this study, the cut-off point for factor loadings values was 0.50 following Madukwe (2004). Therefore, factor loadings less than 0.50 or variables that load in more than one factor were discarded. Three factors were identified, grouped, and named according to their functions Organizational, infrastructure, and financial factors.

Factor 1 that relate to an organization with high loading were lack of availability of professional for training (0.750), gender issues (0.560), lack of government intervention (0.740), and lack of monitoring and evaluation from the Government (0.808*). Factor 2 was infrastructure, those with significant loading among the items were Lack of ICTs infrastructures and Inadequate availability of electricity (0.719). Factor 3 was financial, those with high loading were High cost of equipment (0.840) and poor income (0.977), and lack of policies to enhance government ICTs development in the rural areas (0.853).

Table 3. Distribution of Respondents According to Challenge Faced in ICT Application .

Constraints	Factor 1	Factor2	Factor 3
Weak network connection	0.273	0.032	-0.273
Lack of training opportunity	0.126	0.256	-0.040
Lack of ICTs infrastructure	0.349	0.650*	0.168
High Cost of ICTs tools and Equipment	-0.283	0.490	0.840*
Lack of availability of professionals for training	0.750*	0.195	0.192
Poor income	0.387	0.181	0.977*
Gender Issues	0.560*	0.018	-0.032
Lack of Government intervention	0.740*	-0.280	-0.332
Lack of monitoring and evaluation from the Government	0.808*	-0.388	0.269
Lack of policies to enhance ICTs development in rural areas	-0.302	0.469	0.853*
Farmer's rejections of using ICTs	-0.201	0.280	0.244
Inadequate availability of electricity	0.276	0.719*	-0.198

Extraction Method: Principal Axis Factoring. 3 components were extracted.

Note: Factor 1=Organizational factors, Factor 2=Infrastructural factors and Factor 3=Financial factors

Rotated Method: Varimax with Kaiser Normalization (Loading. 0.5 and above).

Identification of these factors is very crucial, the recommendation proffer in this study will create more efficiency and accuracy in the display of duties among the extension workers. Table 4 represents the total variances that explained the challenges associated with ICTs training and application. After rotation, the following items; lack of availability of professionals for training, gender issues, lack of government intervention, and lack of monitoring and evaluation from the Government which form the first factor and categorize as an organizational factor accounted for 20.5% of the variance of challenges associated with ICTs training and application. The second factor which was the Lack of ICTs infrastructures and Inadequate availability of electricity grouped as infrastructural challenges, accounted for 18.6% of the variances in explaining the total challenges of ICTs training and application faced by extension workers. Finally, the third factor which was the high cost of equipment, poor income, and lack of policies to enhance government ICTs development in the rural areas accounted for 14.04% of the variance in explaining the total challenges encountered

Table 4. Total variance explained on problems associated with ICTs training and application.

	Initial extraction			Extraction Sum of square Loading		
Components	**Total**	**%variances**	**cumulative %**	**Total**	**Variance %**	**Cumulative %**
Weak network connection	2.458	20.46	20.465	2.456	20.465	20.465
Lack of training opportunity	2.233	18.61	39.076	2.233	18.610	39.076
Lack of ICTs infrastructure	1.686	14.05	53.124	1.686	14.048	53.124
High Cost of ICTs tools and equipment	1.144	9.533	62.657			
Lack of availability of professionals for training	1.077	8.972	71.630			
Poor income	0.940	7.836	79.466			
Gender Issues	0.705	5.878	85.344			
Lack of Government intervention	0.687	5.729	91.072			
Lack of monitoring and evaluation from the Government	0.445	3.712	94.784			
Lack of policies to enhance ICTs development in rural areas	0.358	2.985	97.769			
Farmer's rejections of using ICTs	0.196	1.631	99.400			
Inadequate availability of electricity	0.072	600	100.00			

Extraction Method: Principal Component Analysis

among the extension workers. Among the three factors that were grouped and named, the highest factor that contributed most to explaining the challenges of ICTs training and application is factor 1 which is an organizational factor with about 20.5%, followed by factor 2 which accounted for 18.6%.This implies that organizational factors such; as lack of availability of professionals for training, gender issues, lack of government intervention, and lack of monitoring and evaluation from the Government as has the most contribution out of the total challenges facing ICTs training and application among agricultural extension workers.

***The relationship between ICTs application and job performance*:** Table 5, revealed a positive, moderate effect and significant relationship (r=0.309) of ICTs application with job performances of agricultural extension workers at p<0.01. This implies that, as ICTs application increases or decreases, the job performance of extension workers tends to move in the same direction. This finding is relevant based on the fact that the more ICTs application increases, the more job performances of extension workers moderately increase and as ICTs application decreases it moderately decreases in the same direction.

Table 5. Shows the relationship between the use of ICTs and job performance (N=291).

Pearson correlation coefficient	P-Value
0.309**	0.000

**Correlation significant at 0.01 level

***Relationship between ICTs application and each dimension of job performance*:** Table 6, the result indicated that ICTs application was positively and significantly associated (r=0.295), with the Quantity of work. This implies that, as ICTs application increases or decreases, the performances of extension workers in terms of Quantity of work also increase and decrease on the same note. The relationship had a weak impact. At a 99% level of confidence, the relationship was significant, and the variances between the variables were around 9%. ICT application and Quality of work also showed a positive and significant relationship at p<0.01 (r=0.298), indicating a small effect in the relationship with a r2 value of 0.088 suggesting a 9% variance between the variables. ICT application and speed of work also had a positive and statistically significant relationship (r=0.271, p< 0.01), indicating a small effect in the relationship with about 7% variance between the variables. The result of the study implies that ICTs application has a positive, small effect of relationship with job performance in terms of quantity of work, Quality of work, and Speed of work.

Table 6. Relationship between ICTs application and each dimension of job performance.

Dimensions	Pearson correlation coefficient	P-Value
Quantity of work	0.295**	0.000
Quality of work	0.298**	0.000
Speed of work	0.271**	0.000

**Correlation significant at 0.01 level

***Comparison between gender and job performances*:** The result in Table 7, indicated that there was a significant difference between gender and job performances at the 0.05 level of significance, indicating that the males performed at a higher level than the females. This may be because men are

expected to provide for their families in Nigeria, so they will look into every self-development option to enhance their performance at work.

Table 7. Z test for comparison between gender and job performances (N=291).

Gender	Mean	Std. Deviation	Std. Error means	Z-value
Male	4.5027	0.72011	0.09148	0.000
Female	3.9507	0.53648	0.06813	

Source: field survey 2022. Significant at 0.05 level

DISCUSSION

***The application and usage profile of ICTS*:** The result in Table 2 revealed the respondent's ICTs application and usage profile. Based on ranking, the majority 87.6 % of the respondents indicated they often used Facebook, 86.9% WhatsApp, 84.2% internet sources/Mobile/smartphone, Desktop computer 46.7%, 39.2% Laptop computer, 37.5% telegram, IPad/Tablet 34.0%, E-extension 27.5%, 21.9% Twitter, 17.9 % Plantix, 10.6% Plantwise Fact sheet, and Open data ICTs app 3.4%. The outcome of these findings is highly paramount because it showed that extension workers are more exposed to the usage of social media. This implies that they use it in disseminating innovation to farmers which is a fast and cheapest means of communication. In a similar study it was discovered, the majority of respondents in Nigeria used Facebook, What's App, and mobile devices with access to the Internet O'Dea, (2020). The outcomes confirm that the most common ICT device globally utilized are mobile phones and internet access (smartphone). It was also reported, agricultural extension workers in Nigeria's Benue state frequently use mobile phones, radios, televisions, internet-connected computers, and printers (Attah and Otene 2020). Only mobile phones were highly used among the nine CBIT facilities and applications surveyed, whereas I-pads/laptops and YouTube were the least used, according to (Aniefiok *et al.* 2021),

***Problems and challenges faced by ICTs training and Application*:** According to Pallant (2020), to verify that your data set is suitable for factor analysis, the Kaiser-MeyerOlkin Measure of Sampling Adequacy (KMO) value should be .6 or above, and the Bartlett's Test of Sphericity value is significant (i.e. the Sig. value should be .05 or smaller). For this study, the KMO value is .693 and Bartlett's test is significant (p = .000), therefore factor analysis is appropriate. Stevens (1992) suggests using a cut-off of 0.4, irrespective of sample size, for interpretative purposes. When the items have different frequency distributions Tabachnick and Fidell (2007) follow Comrey and Lee (1992) in suggesting using more stringent cut-offs going from 0.32 (*poor*), 0.45 (*fair*), 0.55 (*good*), 0.63 (*very good*) or 0.71 (*excellent).*

The result in Table 3 indicated the challenges faced by respondents in ICTs training and application which were determined using factor analysis. For this study, the cut-off point for factor loadings values was 0.50 following Madukwe (2004). Therefore, factor loadings less than 0.50 or variables that load in more than one factor were discarded. Three factors were identified, grouped, and named according to their functions Organizational, infrastructure, and financial factors. Factor 1 that relate to an organization with high loading were lack of availability of professional for training (.750), gender issues (.560), lack of government intervention (.740), and lack of monitoring and evaluation from the Government (.808*). Factor 2 was infrastructure, those with significant loading among the items were Lack of ICTs infrastructures and Inadequate availability of electricity (.719). Factor 3 was financial, those with high loading were High cost of equipment (.840) and poor income (.977), and lack of policies to enhance government ICTs development in the rural areas (.853). Identification of these factors is very crucial, the recommendation profer in this study will create more efficiency and accuracy in the display of duties among the extension workers. The finding corresponds to that of Attah AJ, Waya DT, and Otene VA. (2020), reported that the constraints faced by respondents in the application of ICTs were determined using factor analysis, and the result shows that, the significant infrastructural constraints were lack/unstable power supply, poor ICT facilities, and bad ICT network service. They further indicated that the Significant financial constraints were the high cost of ICT facilities, the high cost of maintenance of ICTs, and the high cost of alternative power supply. The technological factors with high loading were lack of technical know-how and lack of ICT training programs for extension agents. It is expected that provision of solutions to the problems faced by the extension agents will facilitate their increased use of ICTs and this could mean more effective communication with farmers. provide alternatives to the above mention critical problems. In order hand, the findings of Ali *et al.* (2018), Umar *et al.* (2019), and Dire *et al.* (2016) in separate studies as cited by Saad *et al.* (2022), showed that the perception of the respondents on the problems in using ICTs in extension work differs, on some of the variables (high cost of ICT's, electricity problem, lack of training on ICT, ICT illiteracy, outdated contents in extension massages, inability to use ICT, network issue) were perceived as critical problems in using ICTs in extension work in the study area. This finding implies that for ICT use by the agricultural extension agents to be fully successful in the study area there is an urgent need to remedy, improvise where possible and provide alternatives to the above mention critical problems. Table 4 represents the total variances that explained the challenges associated with ICTs training and application. After rotation, the following items; lack of availability of professionals for training, gender issues, lack of government intervention, and lack of monitoring and evaluation from the

Government which form the first factor and categorize as an organizational factor accounted for 20.5% of the variance of challenges associated with ICTs training and application. The second factor which was the Lack of ICTs infrastructures and Inadequate availability of electricity grouped as infrastructural challenges, accounted for 18.6% of the variances in explaining the total challenges of ICTs training and application faced by extension workers. Finally, the third factor which was the high cost of equipment, poor income, and lack of policies to enhance government ICTs development in the rural areas accounted for 14.04% of the variance in explaining the total challenges encountered among the extension workers. Among the three factors that were grouped and named, the highest factor that contributed most to explaining the challenges of ICTs training and application is factor 1 which is an organizational factor with about 20.5%, followed by factor 2 which accounted for 18.6%. This implies that organizational factors such; as lack of availability of professionals for training, gender issues, lack of government intervention, and lack of monitoring and evaluation from the Government as has the most contribution out of the total challenges facing ICTs training and application among agricultural extension workers.

***Relationship between level of ICTs application and job performances*:** It was indicated that the correlation coefficient r always ranges from -1 to +1. A correlation of +0.10 to +0.29 is typically thought to have a small effect, +0.30 to +0.49 is thought to have a moderate effect size, and +0.50 to +1.0 is thought to have a large effect (Field 2009; Pallant 2011)

The result in Table 5, indicated that the use of ICTs was found to have a positive, moderate effect and significant relationship (r=0.309) with the job performances of agricultural extension workers, at p<0.01. The outcome showed a moderate effect on the correlation between the two variables. This implies that, as ICTs application increases or decreases, the job performance of extension workers tends to move in the same direction. This finding is relevant based on the fact that the more ICTs application increases, the more job performances of extension workers moderately increase and as ICTs application decreases it moderately decreases in the same direction. The result was significant at a 99% confidence level. The r^2 value 0.5476 shows about 54.8% variances between variables. The result is consistence with that of the study of Onyema, and Chiemek (2023) who found that there is a significant positive correlation between ICT usage and the level of employee performance.

***Relationship between ICTs application and each dimension of job performance*:** The result in Table 6 indicated that ICTs application was positively and significantly associated (r=0.295), with the Quantity of work. This implies that, as ICTs application increases or decreases, the performances of extension workers in terms of Quantity of work also increase and decrease on the same note. The relationship had a weak impact. At a 99% level of confidence, the relationship was significant, and the variances between the variables were around 9%. Furthermore, there was also a positive and significant relationship at p<0.01 between ICTs application and Quality of work (r=0.298) indicating a small effect in the relationship with an r^2 value of 0.088 implying 9% variance between the variables. There was also a positive and significant relationship between ICTs application and Speed of work at p<0.01, (r=0.271) signifying also a small effect in the relationship with about 7% variances between variables. The result of the study implies that ICTs application has a relationship with the performances of agricultural extension workers in terms of quantity of work, Quality of work, and Speed of work. However, the relationship has a small effect.

***Comparison between gender and job performances*:** The result in Table 7, indicated that there was a significant difference between gender and job performances at the 0.05 level of significance, indicating that the males performed at a higher level than the females. This may be because men are expected to provide for their families in Nigeria, so they will look into every self-development option to enhance their performance at work. This study supports the findings of other authors who found that gender has a big impact on how motivated and effective employees are at work. Furthermore, empirical evidence has shown that there were gender differences regarding how employees ingratiate themselves and employees' performances (Asadullah *et al.* 2021).

***Conclusion*:** The study sought to assess the ICTs application and its relationship to the job performances of extension workers in North Central Nigeria. Based on the conclusion, a significant majority frequently used Facebook, WhatsApp, and internet sources/mobile/smartphones. Majority own and use a mobile phone, while 85.1% television and 74.4% radio. Among the three factors that were grouped and named, the highest factor that contributed most to explaining the challenges of ICTs training and application is factor 1 which is an organizational factor with about 20.5%, followed by factor 2 which was infrastructural, accounting for 18.6%.

ICTs application was positive, moderate, and significantly related to job performance. Furthermore, ICTs application had positive, small effects and significantly related to quantity, quality, and speed of work (r=0.309). The findings indicated that males significantly perform higher than their female counterparts at a 0.05 level of significance Based on the findings, the following recommendations were made; It is recommended that the Government should intervene through the provision of equality of professional training and set up a good monitoring and evaluation team to encourage effective ICTs application that will be directed towards organizational development. The government should motivate and encourage extension personnel both in the rural and urban areas through the provision of befitting ICTs infrastructure, electricity, agricultural extension grants, and provision of a stronger network. Furthermore, the Government should set up

a policy that will encourage gender equality in terms of ICTs usage for both women and men in agriculture.

***Author's contributions statement*:** Dalibu Bakari; Conceived the idea, designed the study and reviewed the manuscript, collected the data, and wrote the manuscript; Norsida Man; Assisted in reviewing and editing the manuscript; Nolila Mohd Nawi; Reviewed the manuscript and assisted in editing; I Jasmin Arif Shah: Assisted in editing and proofreading.

***Conflict of interest*:** The authors declare that there is no conflict of interest.

***Data Availability*:** The corresponding author is willing to provide some or all of the data, models, or code that support the study's conclusions upon reasonable request.

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